Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission

ASSESSMENT METHODS FOR SKIPJACK IN THE EPO: A PROPOSAL RELYING ON RECENT DATA FROM THE IATTC REGIONAL TUNA TAGGING PROGRAM (2019-2022)

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Outline

- Historical assessment methods
- Tagging data
- Tagging analysis
- Stock assessment
- Workplan
- Summary

Historical assessment methods

- Indicators
- Analysis of tag-recapture data
- Length-structured stock assessment model
- Age-Structured Catch-At-Length Analysis (A-SCALA)
- Spatial Ecosystem and Population Dynamic Model (SEAPODYM)

2000 and 2002 to 2006 tagging cruises

- 2000 and 2002 to 2006
- Six tuna tagging cruises
- Targeting bigeye tuna
- 3,425 skipjack were tagged
- 563 tags recovered (16.4%)

2019 and 2020 (and 2022) tagging cruises

Plastic dart tags

	Returned							
Year	Released	<30	30-89	90-179	180 – 365	>365	Total (%)	Percent High Confidence (n)
2019	177	6	19	5	2	1	35 (19.8)	60.0 (21)
2020	5854	730	466	210	71		1,569 (26.8)	18.3 (287)
All	6031	736	485	215	73	1	1,604 (26.6)	19.2 (308)

Archival tags

	Returned						
Year	Released	<30	30-89	90-179	180 – 365	>365	Total (%)
2019	43	3	0	0	2	0	5 (11.6)
2020	185	10	13	9	3	NA	35 (18.9)
All	228	13	13	9	5	0	40 (17.5)

Tagging model

- Issues
  - Limited tagging opportunities
  - Tags not fully mixed
  - Short lived species

Tagging model

- Combines
  - Advection diffusion model of tagged population
  - Spatio-temporal model of skipjack abundance

Tagging model

$$T_{i,j,t+1} = r_{i,j,t+1} + \sum_{i',j'} \psi_{i',j' \to i,j} \varphi_{i',j',t} T_{i',j',t}$$

Where $T_{i,j,t}$ and $r_{i,j,t}$ are the number of tagged individuals and releases in location *l(i,j)* at time *t*, respectively, $\psi_{i',j' \to i,j}$ is the proportion of the individuals (after survival) that transition from location $l(i',j')$ to location $l(i,j)$ and can be parameterized using advection and diffusion with parameters **u**, **v**, and **D**, and $\varphi_{i,j,t}$ is survival in location $l(i,j)$ at time *t*.

$$\varphi_{i,j,t} = (1 - f_{i,j,t}) e^{-M}$$

$$f_{i,j,t} = \frac{C_{i,j,t}}{N_{i,j,t}}$$

Spatio-temporal model of abundance

$$log(N_{i,j,t}) = \alpha_t + \gamma_{i,j} + \theta_{i,j,t}$$

Where α_t represents a temporal main effect, $\gamma_{i,j}$ represents the spatial component, and $\theta_{i,j,t}$ represents the spatio-temporal interaction term.

The spatial variation, $\gamma_{i,j}$ can be modelled using a Gaussian Random Field (GRF) with a Matérn correlation function and the spatio-temporal component can be modelled by combining the GRF for spatial variation with a first-order autoregressive model for temporal variation following Thorson *et al*. (2015).

Likelihood

$$L(\boldsymbol{\alpha}, \boldsymbol{\sigma}, \boldsymbol{u}, \boldsymbol{v}, \boldsymbol{D}, M | \boldsymbol{R}, \boldsymbol{r}, \boldsymbol{C}) = \sum_{i,j,t} \tau\left(R_{i,j,t}, \hat{R}_{i,j,t}\right)$$

$$\hat{R}_{i,j,t} = f_{i,j,t} T_{i,j,t}$$ ← Tagging model

$$f_{i,j,t} = \frac{C_{i,j,t}}{N_{i,j,t}}$$ ← Spatio-temporal model

Extensions

- Abundance
  - Environmental covariates
  - Spatial population dynamics model
  - Integrated into a stock assessment model
- Size structure
- Archival tags
- Tag loss, tag reporting, tagging related mortality

Stock assessment

- Yield-per-recruit/Spawner-per-recruit
  - Proxy reference points
- Biomass and exploitation rate trends
- Stock assessment
  - Fit to estimates of biomass
  - Integrate tagging data into the assessment (unlikely)

Work plan

- 2022
  - Preliminary results (SAC-13)
  - External review of tagging analysis
- 2023
  - Exploratory assessment (SAC-14)
- 2024
  - Benchmark assessment (SAC-15)

- Data from the 2022 tagging cruise will not be available until early 2023

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Questions